REMARKS

The foregoing amendment amends claims 1-18 for purposes of clarity and adds claims 20-37. Pending in the application are claims 1-37, of which claims 1, 13, 23, 26, 27 and 37 are independent. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Claim 39 is directed to a method for starting a fuel cell, which includes a compressor provided within a circulation line of the fuel cell. Support for the claim is found at least, for example, in Figures 4 and 8 of the application. *No new matter is added.*

Amendment of the claims are not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and were done solely to expedite prosecution of the application. Applicants reserve the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

Objections to the Claims

The Examiner objects to claims 1-19 for certain informalities. Applicants have amended the claims to correct the grammatical errors and improper English. Applicants also amend claims 2, 6-10, 12 and 15-18 to place the claims in proper dependent form, as requested by the Examiner.

35 U.S.C. §112 Rejections

The Examiner rejects claims 2 and 6-19 as being indefinite. Applicants have amended the claims to clarify that the Applicants are claiming an apparatus and request that the rejection under 35 U.S.C. §112 be reconsidered and withdrawn.

Regarding claim 14, Applicants have amended claim 14 to clarify the location of the heat exchanger relative to the compressor.

35 U.S.C. 102 Rejection

In the Office Action, the Examiner rejects claims 1, 3-5, 11-13 and 19 under 35 U.S.C. 102(b) as being anticipated by Strasser (U.S. Patent Number 5,543,238). Applicants respectfully traverse the rejection and submit that the presently pending claims, as identified

above, are patentable over the Strasser reference.

The Strasser reference is concerned with moistening an electrolyte of a fuel cell by recirculating exhaust gas from the cathode of the fuel cell into the cathode of the fuel cell during operation of the fuel cell. The exhaust gas contains water produced during the electrochemical reaction in the fuel cell. The recirculating exhaust gas moistens the electrolyte with the water contained therein. The amount of exhaust gas that is recirculated into the supply gas is set by an adjusting element in proportion to the power output of the fuel cell. The Strasser system includes an air compressor in an air supply line for equalizing the supply air with the input air pressure of the fuel cell. The Strasser system also includes a gas compressor in a circulation line for controlling humidification conditions to the fuel cell.

In contrast, the present invention relates to a method and apparatus for rapidly warming up a fuel cell, which utilizes a means for returning an exhaust gas depending upon the warming-up conditions of the fuel cell (i.e., the temperature of the fuel cell, the temperature of the exhaust gas, the temperature of the coolant, or such). In one embodiment, the means for returning an exhaust gas is a valve 26 that switches between an exhaust position and a returning position. In particular, the use of a compressor in the system of the present invention allows heat, which is generated from adiabatic compression of the exhaust gas by the compressor, to be transmitted to the fuel cell in an effective manner. By switching the valve, the warming-up of the fuel cell can be performed without escaping heat.

According to the Examiner, the Strasser reference, in column 5, lines 31-38, discloses that the amount of exhaust gas that is returned to the air supply line depends on *operational* parameters of the fuel cell, such as the power output of the fuel cell. However, the Strasser reference does not teach or suggest that the return of the exhaust gas to the supply gas depends upon the warming-up conditions of the fuel cell, as recited in claim 1. Specifically, the Strasser reference does not teach or suggest that the return of the exhaust gas to the supply gas depends upon the conditions when the supply gas is supplied to the fuel cell and exhausted as exhaust gas, as recited in claim 1. Furthermore, Strasser merely *varies* an amount of exhaust gas that is recirculated based on the output power of the fuel cell and does not teach or suggest determining whether to recirculate all or none of the exhaust gas based on conditions of the fuel cell, which is a feature of the present invention.

The present invention recirculates exhaust air before the fuel cell produces any power, during a warming-up period. In contrast, the Strasser reference indicates that a portion of the exhaust gas is reintroduced into the recirculation line as a function of the output power from the fuel cell, i.e., during operation of the fuel cell and after warm up has already occurred. Therefore, claim 1, and claims 2-12, which depend on claim 1, are patentable over the cited Strasser reference.

Regarding claim 13, the Strasser reference describes a gas compressor 36 in the recirculation line, which compresses the recirculated exhaust gas to the input air pressure of the air gas chamber 8 of the fuel cell. According to the Examiner, a gas under pressure inherently increases in temperature. Therefore, the compression of the recirculated exhaust gas inherently heats the supply gas in Strasser.

However, the Strasser reference recirculates and compresses only a *portion* of the exhaust gas that is discharged from a fuel cell, while the remaining exhaust gas passes through the exhaust-gas line, as described in column 5, lines 46-47. Strasser teaches away from recirculating all of the exhaust gas for a predetermined time period, because Strasser specifies that the remaining exhaust gas (the portion that is discharged and not recirculated) is used to power an exhaust-gas relief turbine, which drives other components of the system. Thus, only a portion of the exhaust gas recirculates and passes through the compressor and into the cathode.

Amended claim 13 specifically recites that the compressor compresses all of the exhaust gas produced by the fuel cell, a feature lacking in the Strasser reference.

New Claims

Claims 20-37 have been added to more fully claim the instant invention. Claims 20-22 depend from claim 1, and recite additional features not taught or suggested in the prior art. For example, claim 20 recites that the means for returning an exhaust gas comprises a three-way valve that switches between an exhaust position and a returning position. This recitation defines over the Strasser reference because the adjusting element in the Strasser reference recirculates a *portion* of the exhaust gas and simultaneously discharges the remaining exhaust

gas. Therefore, Strasser clearly does not comprise a three-way valve that switches between two discrete modes.

New independent claim 23 specifies that the means for returning an exhaust gas returns the exhaust gas to the supply gas when the temperature of the exhaust gas is below a predetermined level, a feature neither taught nor suggested in the cited prior art. Claim 24 depends on 23 and further specifies that the means for returning an exhaust gas discharges the exhaust gas when the temperature of the exhaust gas exceeds the predetermined level. Claim 25 specifies that the means for returning the exhaust gas returns all of the exhaust gas when the temperature of the exhaust gas is below a predetermined level. The Strasser reference does not teach or suggest recycling an exhaust gas based on the temperature of the exhaust gas. In fact, the Strasser reference teaches away from claim 23, because the Strasser reference described returning an exhaust gas to a cathode inlet during operation, i.e., after the temperature of the exhaust gas *exceeds* a predetermined level.

New independent claim 26 specifies that the means for returning an exhaust gas returns the exhaust gas to the supply gas depending upon the conditions of the supply gas when the supply gas is supplied into the fuel cell and the conditions of the exhaust gas after the fuel cell discharges the exhaust gas. The Strasser reference does not teach or suggest that the recirculation of an exhaust gas depends on these conditions. Rather, the Strasser reference determines an *amount* of exhaust gas that is returned based on the *power output* of the fuel cell.

Claims 27-36 are method claims directed to a method of warming-up a fuel cell. Independent claim 27 recites the steps of measuring the temperature of an exhaust gas and returning the exhaust gas to the supply gas when the temperature of the exhaust gas is lower than a predetermined level. The Strasser reference, which is concerned with moistening an electrolyte during operation of a fuel cell, does not teach or suggest the method set forth in claims 27-36.

Claim 37 is directed to a method for starting a fuel cell, which includes a compressor provided within a circulation line of the fuel cell. The method of starting the fuel cell comprises the step of supplying a supply gas to a cathode of a fuel cell. The fuel cell reacts the supply gas to produce an exhaust gas. The method further comprises the steps of drawing

the exhaust gas using a compressor and returning exhaust gas that has been heated through adiabatic compression in the compressor to the supply gas. The Strasser reference does not teach or suggest returning exhaust gas that has been heated through the adiabatic compression in a compressor to a supply gas for a fuel cell, as recited in claim 37.

Information Disclosure Statement

Applicants have filed herewith an Information Disclosure Statement to make U.S. Patent Numbers 5,441,819, 6,106,964 and 6,497,971 A of record during the prosecution of the above-referenced patent application. Applicants do not consider the cited reference to detract from the patentability of the pending claims, as the cited reference does not teach or suggest the claimed invention.

CONCLUSION

For these reasons, Applicants contend that claims 1-37 are patentable and that the claims are clear and definite. As such, the Examiner's objections and rejections so far as they are based upon 35 U.S.C. §112 and 35 U.S.C. §102 should be reconsidered and withdrawn. Allowance of the pending claims at an early date is solicited.

If, however, the Examiner considers that obstacles to allowance of these claims persist, we invite a telephone call to Applicants' representative.

Respectfully submitted,

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